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Maritimes Region
Canadian Science Advisory Secretariat
Science Advisory Report 2010/039

ASSESSMENT OF SCALLOPS (*PLACOPECTEN MAGELLANICUS*) IN SCALLOP FISHING AREA (SFA) 29 WEST OF LONGITUDE 65°30'W

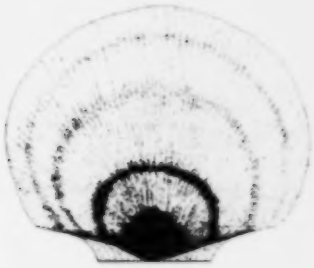


Figure 1. Location of the portion of SFA 29 west of longitude 65°30'W. Refer to full detail map in Appendix 1 for locations and place names.

Context:

Scallop Fishing Area (SFA) 29 encompasses a very large inshore area inside the 12-mile territorial sea, from the south of Yarmouth (latitude 43°40'N) to Cape North in Cape Breton. This report refers to only that portion of SFA 29 west of longitude 65°30'W continuing north to SPA 3 at latitude 43°40'N (Figure 1), hereafter referred to as SFA 29 West.

Prior to 1986, the Full Bay Scallop Fleet fished in this area. Following the 1986 inshore/offshore scallop fishing agreement, fishing by the Full Bay Fleet was restricted to north of latitude 43°40'N. A limited fishery by the Full Bay Fleet was granted from 1996–98. Access was again granted to this fleet in 2001 with a full at-sea monitoring program and with a condition of a post-season industry-funded survey. SFA 29 West is within Lobster Fishing Area (LFA) 34 and, as a result, scallop fishers consulted with lobster fishers in the area to deal with potential conflicts. Lobster and by-catch of other species continue to be monitored in this fishery.

In 2002, Fisheries and Oceans approved access to this area by the Full Bay Fleet and inshore East of Baccaro licence holders who are eligible to fish in SFA 29 West. SFA 29 inshore scallop licenses were historically restricted to East of Baccaro (east of longitude 65°30'W). A joint project agreement was signed with the fishing fleets, Natural Resources Canada, and Fisheries and Oceans Canada with all parties providing funds to conduct multi-beam acoustic mapping of the seafloor and other scientific work. A map showing bottom features for the entire area has been prepared and was distributed to the fishermen for the 2004 fishery. Work continues on analyzing surficial geology and the spatial distribution of scallops.

Advice on Total Allowable Catch (TAC) for this area has been provided annually and is based on survey estimates of abundance and commercial catch rates. There is no framework or reference points for the fishery in SFA 29 West at this time.

Canada

SUMMARY

- This scallop fishery has taken place in the portion of Scallop Fishing Area (SFA) 29 west of longitude 65°30' W since 2001 and is currently conducted by two fleets: the Full Bay Fleet and a limited number of inshore East of Baccaro licence holders (i.e., East of Baccaro Fleet).

- During 2009, a total of 242 t (158 t Full Bay; 84 t East of Baccaro) was landed against a TAC of 250 t.

- Fishing activity in subareas A and E has been sporadic during the last three years, and commercial catch rates in these areas appear to have generally increased since 2007. In subarea B, 2009 commercial catch rates for the Full Bay and East of Baccaro fleets increased from 2008 by 13 and 16%, respectively. The Full Bay and East of Baccaro fleet catch rates in 2009 for subarea C both decreased by 8% from 2008. In 2009, the catch rate for Full Bay remained the same as in 2008, while it continued to decline for East of Baccaro (by 10%).

- All survey abundance indices show a general declining trend since the fishery began in 2001 (2004 for subarea D). Recruitment is presently low in all subareas.

- Two methods were used to estimate exploitation rates in SFA 29 West: one from commercial catch rates, representing more localized conditions, and one from the research survey, which represents broader conditions. Results from both methods were generally consistent. Overall, the exploitation rates estimated for subareas A to D have increased from 2008 to 2009, except in subarea B.

- By-catch of lobster by the SFA 29 West scallop fishery in 2009 was estimated at less than 0.1% of the weight of lobsters landed by the Lobster Fishing Area 34 lobster fishery corresponding to the SFA 29 West area in 2008/2009. All lobsters caught in the scallop fishery were released back into the water, the majority of which were alive and uninjured.

- In subarea A, 2009 exploitation rates from the research survey and commercial catch rates were estimated to be <0.01 and 0.03, respectively. Growth in biomass is expected to be 8% from 2009 to 2010, and there is expected to be little recruitment based on the survey. Landings of 5 t did not result in an appreciable decline in biomass in 2009 and would not be expected to result in an appreciable decline in biomass in 2010.

- In subarea B, 2009 exploitation rates from the research survey and commercial catch rates were estimated to be 0.07 and 0.15, respectively. Growth in biomass is expected to be 14% from 2009 to 2010. Recruitment levels are currently low. Landings of 60 t did not result in an appreciable decline in biomass in 2009 and would not be expected to result in an appreciable decline in biomass in 2010.

- In subarea C, 2009 exploitation rates from the research survey and commercial catch rates were estimated to be 0.26 and 0.32, respectively, both of which exceeded the growth rate (20%) and recruitment from 2008 to 2009. Growth in biomass is only expected to be around 14% from 2009 to 2010 based on the average meat weight of the commercial and recruit size scallops in 2009. Using the survey estimates, catch levels that correspond to a 0.2 exploitation rate (target used in the Bay of Fundy) would be 42 t.

- In subarea D, 2009 exploitation rates from the research survey and commercial catch rates were estimated to be 0.27 and 0.39, respectively. Growth in biomass is only expected to be 15% in 2009/2010 compared to 17% in the previous year. Using the survey estimates, catch levels that correspond to a 0.2 exploitation rate (target used in the Bay of Fundy) would be 64 t.

BACKGROUND

Species Biology

The sea scallop (*Placopecten magellanicus*) occurs only in the northwest Atlantic Ocean from Virginia north to Labrador. Within this area, scallops are concentrated in persistent, geographically discrete aggregates or "beds", many of which support valuable commercial fisheries. Scallops in different beds and in different areas of large beds show different growth rates and meat yields.

Unlike many commercial scallop species, the sea scallop has separate sexes. Male scallops develop a white gonad in the summer months, while female gonads are bright red. Eggs and sperm are released into the water and fertilization takes place in the sea. Spawning begins in late August to early September, and the larvae drift in the water for almost a month before settling to the bottom in October.

Rationale for Assessment

A meeting of the Regional Science Advisory Process was held 25 March 2010 at the Bedford Institute of Oceanography (BIO), in Dartmouth, Nova Scotia to review the 2009 fishery and assess the status of the scallop stock in SFA 29 West in support of the management of the 2010 fishery. Participants included DFO scientists, fishery managers, industry, First Nations and Aboriginal communities. Specifically, the meeting was called to provide science advice for SFA 29 West scallop fisheries by subarea using analyses of catch rate and survey biomass trends. In addition, an assessment of the lobster by-catch was also provided.

ASSESSMENT

Fishery

This scallop fishery has taken place in the portion of SFA 29 west of longitude 65°30' W since 2001. The Full Bay (FB) scallop fleet was the sole participant in 2001. Starting in 2002, the total allowable catch (TAC) was shared between the Full Bay Fleet and a limited number of inshore East of Baccaro (EoB) licence holders who are eligible to fish in SFA 29 West (i.e., East of Baccaro Fleet). Landings have ranged from 221 to 713 t (Figure 2). Low catches in 2003 were due to a short season caused by a delayed opening. During 2009, a total of 242 t (158 t Full Bay; 84 t East of Baccaro) was landed against a TAC of 250 t (Table 1).

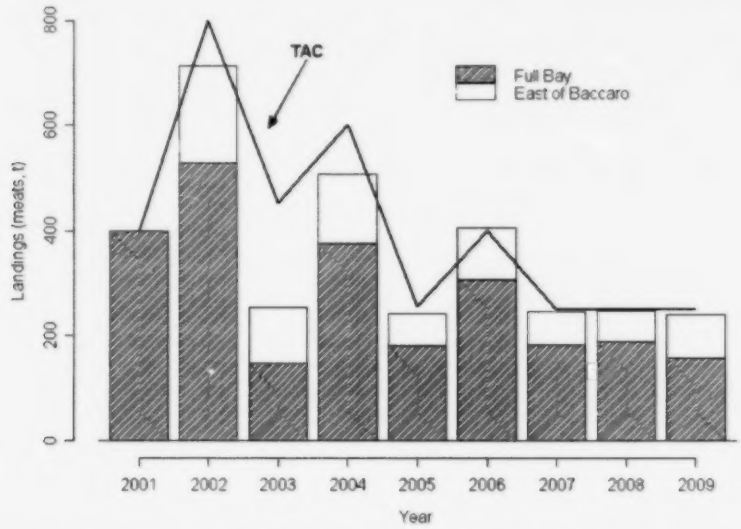


Figure 2. Scallop landings (meats, t) by fleet and total TAC for SFA 29 West.

SFA 29 is divided into 5 subareas (A-E, Appendix 1). All subareas opened for the 2009 fishing season on June 22. The TACs for subarea D were overrun by 22% for the Full Bay fleet (closed July 4th) and 6% for East of Baccaro (closed July 14th). Subarea C closed on August 1st for both fleets with very small quota overruns (FB - 3%, EoB - 4%). The TAC was not reached in subareas A, B or E and these subareas closed on August 31. Two closed areas within subarea B were instituted for both fleets in response to lobster by-catch reports on July 16th and August 20th.

Table 1. Scallop landings (meats, t) and TACs for SFA 29 West.

		Full Bay		East of Baccaro		Total	
Year	Subarea	TAC	Landings	TAC	Landings	TAC	Landings
2008	29A	7.5[1]	3.05	2.5[1]		10[1]	3.05
	29E		0.65		0.44		1.09
	29B	82.50	44.65	27.5	20.75	110	65.40
	29C	33.75	42.05	11.25	13.35	45	54.40
	29D	63.75	99.37	21.25	26.02	85	125.39
	Total	187.50	189.77	62.50	59.54	250	249.33
2009[2]	29A	9.75[1]	4.47	5.25[1]	0.05	15[1]	4.5
	29E		0.01		1.96		1.96
	29B	48.75	36.46	26.25	23.43	75	59.88
	29C	48.75	50.19	26.25	27.34	75	77.54
	29D	55.25	67.20	29.75	31.46	85	98.66
	Total	162.50	158.32	87.50	84.23	250	242.56

[1] TAC for 29A and E combined.
[2] Preliminary landings (as of 2 March 2010).

Resource Assessment

Commercial Catch Rates

Fishing activity in subareas A and E has been sporadic during the last three years, and commercial catch rates in these areas appear to have generally increased since 2007 (Figure 3). In subarea B, 2009 commercial catch rates for the Full Bay and East of Baccaro fleets increased from 2008 by 13 and 16%, respectively. The Full Bay and East of Baccaro fleet catch rates in 2009 for subarea C both decreased by 8% from 2008. Catch rates have declined (31 to 34%) for both fleets in subarea D from 2005 to 2008. In 2009, the catch rate for Full Bay remained the same as in 2008, while it continued to decline for East of Baccaro (by 10%).

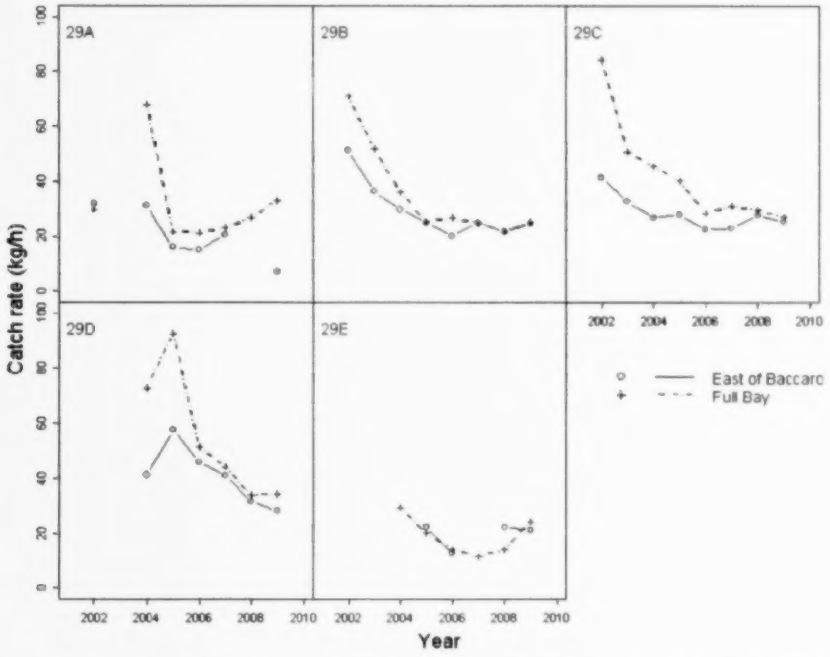


Figure 3. Mean commercial catch rate (kg/h) trends for SFA 29 West scallop fishery for each subarea by fleet.

Research Survey Indices

A post-season joint industry/departmental research survey has been conducted each year since 2001. During this time, there have been four industry vessels involved. In 2001, the survey was based upon a simple random sampling design over the whole area. From 2002 to 2004, subareas A–E were defined to be strata, with random sampling within strata. Subarea E has not been consistently covered in the survey due to time limitations; this subarea is considered to be marginal habitat for scallops and, as a result, has been less of a survey priority. In 2005, stratification was based upon the surficial bottom types identified from the multi-beam mapping and surficial geology groundtruth analysis in SFA 29 West. In 2006 and 2007, tows were allocated randomly to surficial strata within subareas. A new interpretation of the surficial geology introduced in 2008 that included information from side-scan sonar and seismic data

was used to design the survey in 2008 and 2009. Survey estimates from 2001 to 2009 have been modified to correspond to this new design.

Time trends for the abundance of commercial size scallops (≥100 mm shell height) and recruits (90–99 mm shell height) are plotted in Figure 4. All survey abundance indices show a general declining trend since the fishery began in 2001 (2004 for subarea D). Recruitment is presently low in all subareas.

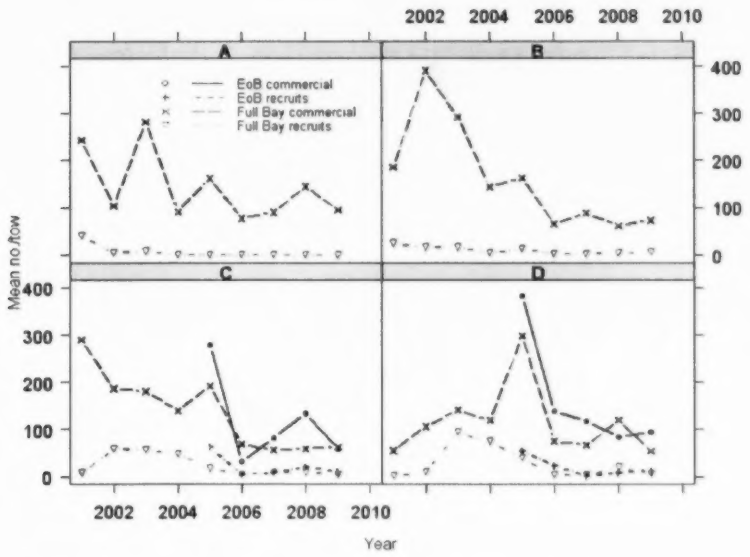


Figure 4. Annual trends of commercial (≥100 mm) and recruit (90–99 mm) size scallop mean number per tow from research surveys by subarea in SFA 29 West. Full Bay commercial and Full Bay recruits estimated from the Full Bay industry vessels: F/V Julie Ann Joan (2001–2003, 2005–2009) and F/V Branntelle (2004). EoB commercial and EoB recruits estimated from the East of Baccaro industry vessels: F/V Overton Bay (2005) and F/V Faith Alone (2006–2009).

The survey index for commercial size scallops in subarea A has fluctuated over the time series and, given the patchy nature of the distribution of scallops in this subarea, survey trends may not reflect actual population trends. As with previous years, there were mainly commercial sized scallops in subarea A with no evidence of recruitment for 2010.

The survey index in subarea B has indicated a general decline in abundance since 2002 with little change in abundance after 2006. Recruitment continues to be low in this subarea.

After an initial decline in number per tow from 2001 to 2002, there appeared to be three stronger than average year-classes in subarea C, but they contributed little to changes in the abundance of commercial size scallops. There was a decline in the survey index from 2005 to 2006. From 2006 to the present, recruitment has continued to be low, with the Full Bay survey indicating a stable commercial size population. The East of Baccaro survey indicated increasing abundance from 2006 to 2008 and a decline in 2009 so that the abundance indices are the same for both surveys in 2009.

The strong year-class observed in the 2003 survey in subarea D and expected to recruit in 2004 did not appear to be as strong in the 2004 survey. However, both the Full Bay and East of

Baccaro surveys identified a peak in abundance in 2005. The Full Bay survey index indicated a decline in the abundance of commercial size scallops from 2008 to 2009, while the East of Baccaro survey index showed little change since 2006. Recruitment has been low since 2005 in both indices.

Exploitation Rate Estimates

Two methods were used to estimate exploitation rates in SFA 29 West: one from commercial catch rates (depletion model approach), representing more localized conditions, and one from the research survey (biomass dynamics model approach), which represents broader conditions.

A **depletion model** was fit to the daily commercial catch rate data to estimate exploitation rate in each fishing season for 2002 to 2009. One of the main assumptions for this model is that all changes in the population during the season were only due to removals from the fishery. Given the short season for this fishery, this assumption should be met. The model was improved from previous years by making use of information from all years to get better estimates of the catchability. This meant that estimates of exploitation rates could be made for subareas and years that were previously unreliable.

Exploitation rates have varied in subarea A along with the sporadic nature of the fishery. In 2004, when landings were 81 t, the exploitation peaked at 0.45, while in 2009, with landings less than 5 t, the exploitation was only 0.03. In subarea B, exploitation rates ranged from 0.13 to 0.22 in all years except 2005, in which it was 0.52. In subarea C, the exploitation rate was 0.78 in 2002, 0.42–0.53 from 2004–2006, and 0.25–0.32 from 2007–2009. The exploitation rate in subarea D was 0.78 in 2004. Subarea D was only partially opened that year, and the exploitation rate estimates only apply to the relatively small opened area. Exploitation was lower between 2005 and 2007 but has been increasing since, and it was estimated to be 0.4 in 2009. Overall, the estimates of exploitation in all subareas (A to D) have increased from 2008 to 2009.

A simplified version of **biomass dynamics model** used for scallop in the Bay of Fundy was fit to the SFA 29 West survey biomass time series to estimate the rate of increase/decrease of the commercial biomass. Catch was not required for this version of the model. Exploitation rate was estimated by modelling growth separately and assuming a natural mortality of 0.1.

Exploitation rates ranged from 0.06 to less than 0.01 in subarea A for the period 2006 to 2009. In 2009 the exploitation rate for subarea B was estimated to be 0.07 (59.9 t landings), lower than the 0.31 estimated for 2006 associated with a catch of 115.6 t. The exploitation rate varied from 0.41 to 0.09 in subarea C and was estimated to be 0.26 for 2009. The range of exploitation rates was lower in subarea D (0.21 to 0.31) with an estimate of 0.27 for 2009.

Results from both methods were generally consistent (Figure 5). Overall, the exploitation rates estimated for subareas A to D from both methods have increased from 2008 to 2009, except in subarea B.

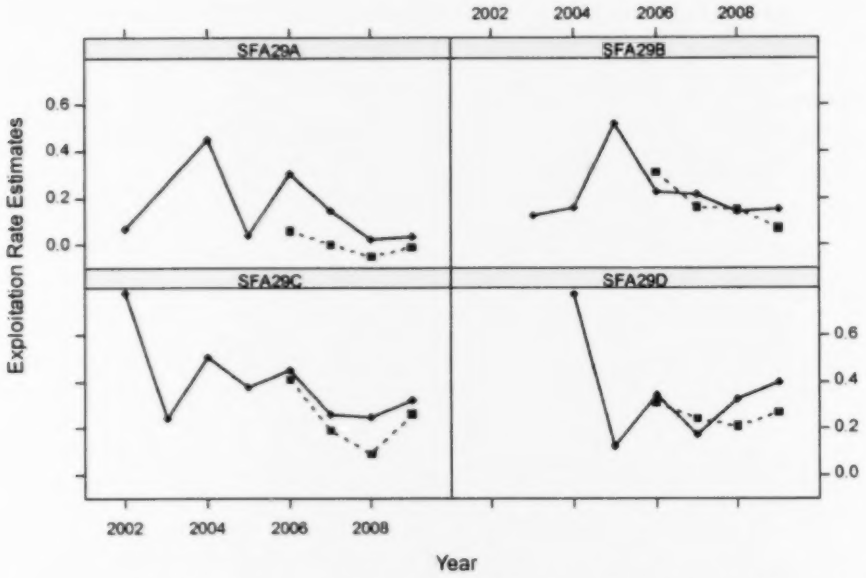


Figure 5. Comparison of the trend in exploitation rates estimated from the depletion model based on fishery data (•), or the biomass dynamics model based on data from the research survey (■) for SFA 29 West by subarea.

By-catch

A DFO project to review by-catch from a variety of fisheries is ongoing, and an assessment of lobster by-catch in the SFA 29 West fishery is presented here. By-catch information on non-lobster species was not available in time for this meeting.

The mean number of lobsters per tow in the 2009 scallop survey was highest in subarea C with 0.6 (FB) or 4.4 (EoB) lobsters per tow depending on the survey. Subarea A had 1.8 lobsters per tow on average and subarea B had 1.6 lobster per tow. Subarea B had the highest catch rate of lobsters for most of the period from 2001–2008. Subarea D had 0.0 (FB) to 0.7 (EoB) lobster per tow depending on the survey (Figure 6).

The level of observer coverage has been variable over the history of this fishery. The requirement is one observed day per active vessel. While all subareas received observer coverage, emphasis was placed on subarea B where lobster by-catch has been higher in the past and closed areas are implemented (Figure 7).

The size of lobsters from observed trips ranged from 35 mm carapace length (CL) to 137 mm CL, but most lobsters were between 60 and 100 mm CL. The size distribution lacks the strong mode at 75 mm, the larger sizes seen in 2008, and is more evenly distributed over the 60–95 mm CL size ranges.

Most lobsters caught during observed fishing trips were in subarea B similar to previous years (Figure 7). Portions of subarea B were closed due to high rate of lobster capture per ton of scallop meats. In subareas C and D, most tows had zero lobsters. Of the 624 lobsters caught during observed trips as by-catch in 2009, 301 were classed as uninjured, 86 were injured, 35 were dead and the condition was not recorded for 202. The estimated total number of lobsters

caught as a by-catch during scallop fishing in SFA 29 West in 2009 was 2,583 with an estimated weight of 1.3 t. This weight of lobsters would represent a small fraction (< 0.1%) of the lobsters landed by the LFA 34 lobster fishery corresponding to the SFA 29 West area in 2008/2009. All lobsters caught in the scallop fishery were released back into the water, the majority of which were alive and uninjured.

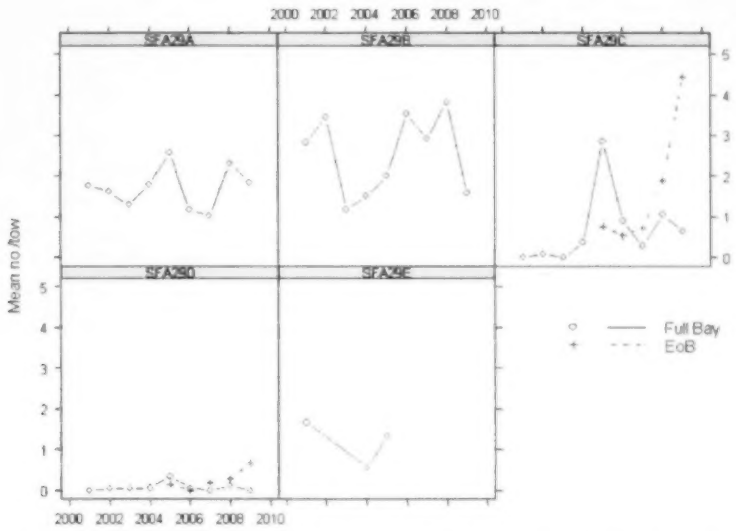


Figure 6. Mean number of lobsters per tow from annual scallop surveys of SFA 29 West.

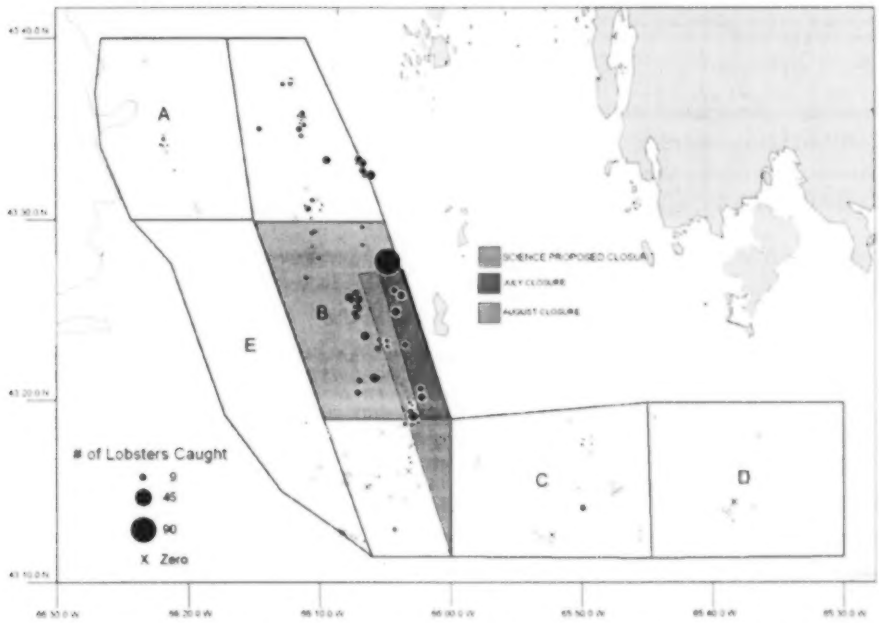


Figure 7. Location and number of lobsters caught in SFA 29 West during 2009 from observed scallop fishing trips. Crosses indicate locations where no lobsters were captured. Areas closed in subarea B during the fishery due to lobster by-catch are indicated by the red and blue polygons. The green polygon is the area proposed by science prior to the 2009 season.

Sources of Uncertainty

The assumptions of no recruitment, natural mortality, equal vulnerability of commercial size scallops to the fishing gear, and minimal growth during the period of the fishery in the depletion model analysis have not been verified.

Exploitation rate estimates from the biomass dynamics model assume a constant natural mortality of 0.1, which has not been verified, and assumes that survey biomass is proportional to population biomass.

The short times series for this fishery (2001–2009) make it difficult to fit full population dynamic models to survey estimates and catch.

CONCLUSIONS AND ADVICE

In subarea A, 2009 exploitation rates from the research survey and commercial catch rates were estimated to be <0.01 and 0.03, respectively. Growth in biomass is expected to be 8% from 2009 to 2010, and there is expected to be little recruitment based on the survey. Landings of 5 t did not result in an appreciable decline in biomass in 2009 and would not be expected to result in an appreciable decline in biomass in 2010.

In subarea B, 2009 exploitation rates from the research survey and commercial catch rates were estimated to be 0.07 and 0.15, respectively. Growth in biomass is expected to be 14% from 2009 to 2010. Recruitment levels are currently low. Landings of 60 t did not result in an appreciable decline in biomass in 2009 and would not be expected to result in an appreciable decline in biomass in 2010.

In subarea C, 2009 exploitation rates from the research survey and commercial catch rates were estimated to be 0.26 and 0.32, respectively, both of which exceeded the growth rate (20%) and recruitment from 2008 to 2009. Growth in biomass is only expected to be around 14% from 2009 to 2010 based on the average meat weight of the commercial and recruit size scallops in 2009. Using the survey estimates, catch levels that correspond to a 0.2 exploitation rate (target used in the Bay of Fundy) would be 42 t.

In subarea D, 2009 exploitation rates from the research survey and commercial catch rates were estimated to be 0.27 and 0.39, respectively. Growth in biomass is only expected to be 15% in 2009/2010 compared to 17% in the previous year. Using the survey estimates, catch levels that correspond to a 0.2 exploitation rate (target used in the Bay of Fundy) would be 64 t.

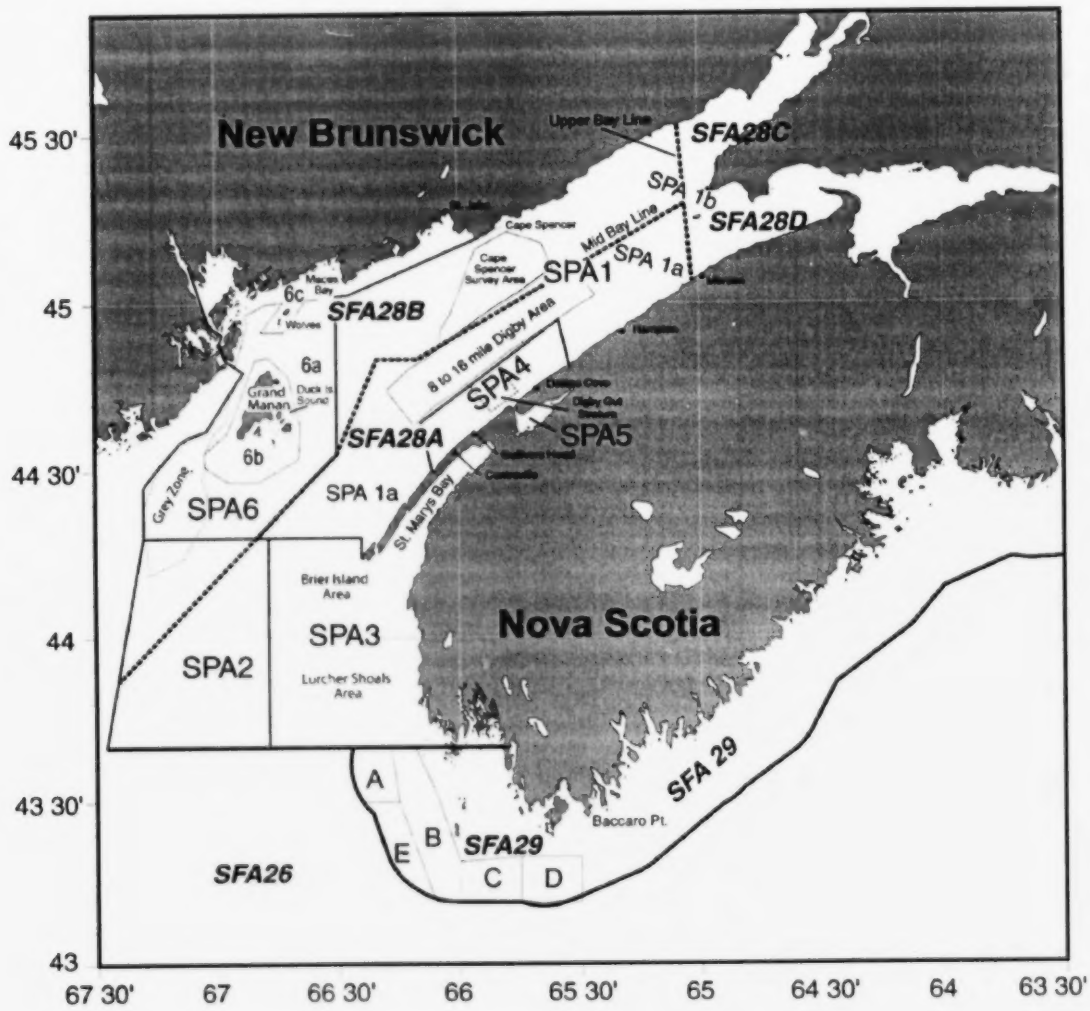
OTHER CONSIDERATIONS

During the July–October moulting period, lobsters are less mobile, more prone to injury, and involved in mating. Measures have been taken by DFO and the fishing industry to avoid scallop fishing in areas where, or at times when, lobsters are in high concentrations or are soft-shelled. The closure of a portion of subarea B in this and previous years due to high lobster by-catch has been an example of the type of measure that could be employed. Setting the start date for this fishery as early as possible in June may help to avoid having the scallop fishery overlap with the lobster moulting period.

SOURCES OF INFORMATION

Smith, S.J., B. Hubley, D. Pezzack, C. Denton, M.J. Lundy, and J. Sameoto. 2010. Scallop Fishing Area 29: Stock Status and Update for 2010. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/057.

Appendix 1. Locations and place names for inshore scallop grounds.



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